DOCUMENT RESUME

ED 449 587 EC 308 191

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TITLE	Actualizing Mathematical Giftedness in Adulthood.
PUB DATE	2000-08-00
NOTE	13p.; Paper presented at the ECHA Conference (Debrecen, Hungary, August 2000).
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Academically Gifted; Adults; *Competition; Education Work Relationship; Enrichment Activities; Followup Studies; Foreign Countries; Graduate Surveys; High Schools; *Mathematics; Outcomes of Education; *Participant Satisfaction; Program Effectiveness; Sciences; *Self Evaluation (Individuals); Surveys
IDENTIFIERS	*Finland; Mathematical Olympiad; Science Olympiad

ABSTRACT

This study followed up gifted Finnish students who participated in Olympiad mathematics and scientific competitions during the years 1965-1997. Survey responses were received from 158 former Olympians (150 males, 8 females) and 169 of their parents. The responding Olympians had competed in mathematics (N=73), physics (N=50), and chemistry (N=35) and their ages at follow-up ranged from under 21 to 50. Analysis of survey responses focused on: (1) the influence of family and school; (2) actualizing mathematical giftedness in Olympians' professional lives; and (3) how Olympians explain their academic and professional success. Overall, findings indicated that: the Finnish Olympians actualized their mathematical talent by choosing a career in science and most of them became researchers in academia or engineers in technical fields; Olympians have been very successful in their graduate studies and have published books and articles; Olympians are independent learners who attribute their academic success to both ability and effort; the Olympiad program tended to increase participants' self-confidence and confirmed career choices already made; and Olympians have been motivated mostly by their own inner drive, although they credit a conducive home atmosphere and supportive teachers as helpful. (Contains 13 references.) (DB)

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Actualizing Mathematical Giftedness in Adulthood

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ED 449 587

Introduction

The purpose of this study is to investigate how gifted Finns have actualized their giftedness in their studies and in their professional life. The gifted population is represented by those gifted in science who participated in the Olympics in mathematical subjects during a period of some thirty years (N=300). The study is a part of an international research project that compares the opportunities for gifted people in different countries to actualize their giftedness. The other countries involved in this project are the USA, Germany, Taiwan and Korea. A special interest is shown in the factors of education, both in homes and in schools, that have helped or hindered these people in the actualization of their giftedness. Furthermore, the self-perceptions of the Olympians regarding the attributions of ability and effort in their success are investigated within the theoretical framework of Weiner's theory (1980).

In recent years, Finland has made an effort to increase educational opportunities for gifted students. These opportunities include flexible decisions in acceleration and ungraded schools, allowing students to advance in their studies with a flexible schedule. Several enrichment alternatives include intensive summer camps in mathematics and Open University programs in math and physics. These projects are available to gifted learners on a voluntary basis (Tirri 1997).

The official educational policy in Finland advocates increasing studies in science and mathematics. Computer skills and the new information technology have also received special attention in the national Finnish educational strategy (Ministry of Education 1995). Finland has participated in Olympiad programs for several years. Separate programs exist for the Math, Physics and Chemistry Olympiads. In recent years, programs have been created for Biology and Computer Science Olympiads as well. Distinct studies have been undertaken in each of these academic areas. In the Math, Physics and Chemistry Olympiad programs, series of increasingly difficult tests are administered. This testing concludes with the identification of the top national finalists (6-20 Olympians). These individuals are trained to compete in the International Olympiad programs. In this paper, we report findings on Olympians of different ages who participated in Olympiad Studies in math, physics or chemistry during the years 1965-1997. A special interest is shown in the influences of home and school in contributing to the development of academic talent. The results of the Finnish study are compared to the earlier American study using the same instruments (Campbell 1996b).

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The Olympians in Finland were mailed a 14-page questionnaire and self-confidence attitude attribute scales (SaaS) (Campbell 1996a). Their parents were mailed a shorter version of the same questionnaire and the inventory of parental influence (IPI) (Campbell 1996a). The duplication of questions from both sources was employed to assure validity in the responses and also to compare the varying perceptions of parents and their children. Two sets of mailings were used during an eight-month period, with packets being sent to all the Olympians in math, physics and chemistry whose current addresses could be found. The packets included questionnaires for both the Olympians and their parents. The Olympians were asked to forward the parent questionnaire to their own parents. Four Olympians were dead, ten of them kept their current addresses private, twenty of them could not be located and ten of them lived outside of Finland. The sample, then, consisted of 242 Olympians with valid addresses. The response rate from these Olympians was 65% (158 usable replies), and from their parents the response rate was 70% (169 responses).

Finnish Olympians' data came from 150 males and (only) 8 females. The total number of females who participated in the Olympics during the years 1965-1997 is fourteen. The sample consists of 73 in mathematics, 50 in physics and 35 in chemistry. The data includes Olympians of different ages, with the oldest being over 50 years of age. Some of them had participated in the first Olympiad competition in mathematics in 1965. The data include very young Olympians, less than 21 years of age, who have participated in the Olympics in recent years. However, the majority of the Olympians (over 80%) belong to the age groups between 21 and 40 (see Table 1).

Table 1. Description of Finnish Olympians

Sex	(N)	(%)
Male	150	96
Female	8	5
Subject		
Mathematics	73	46
Physics	50	32
Chemistry	35	22
Age group		
Under 21	4	3
21-30	65	41
31-40	63	40
41-50	17	11
Over 50	4	3
Missing	4	3

The factors contributing to the development of mathematical giftedness of the Olympians

The influence of family and school

More than a half of the Olympians were first-born children in families. This is not a surprising finding since the research on families of gifted and talented children indicates that the first-born children have higher IQ scores and they usually achieve more than their siblings throughout life (Freeman 1993, Walberg & Marjoribanks 1976, Walberg & Starhia 1992). In an American study, two-thirds (66%) of the Olympians were first-born children from small families (1.42 children) (Campbell 1996b). In the Finnish study, the Olympians came from larger families. Only eleven of the Olympians were only children and 55% of them had two or more siblings. The majority of the Finnish Olympians (33%) came from homes with a high-level socioeconomic status.

The Finnish Olympians were all very successful at school. Most of them ranked at least in the top ten among graduates of their high school. Most of the Finnish Olympians did not take part in any kind of special educational arrangements for gifted children during their years at school. These arrangements include opportunities to study according to an advanced program or a special class for gifted students. The Finnish Olympians and their parents were asked to rate the importance of family/school influences to the development of the academic talent of the Olympian. Parents rated all the family and school influences as being more important than did the Olympians. On the other hand, the Olympians, regardless of their socioeconomic status, viewed themselves as the most influential person in the development of their giftedness (Tirri 2000).

Both the Olympians and their parents rated the item "Home atmosphere was very conducive to learning" as the most influential factor in their talent development. The parents and the Olympians agreed on the importance of "A great teacher(s)" and ranked that item second. In addition to the quantitative scale, the Olympians were given a chance to describe other factors that helped them to develop their talent. The most frequently mentioned factor (N=15) was their active use of a library. Finland has invested in public libraries and bookmobiles that bring books even to isolated areas throughout the country. An effective library service can be one explanation for the high reading literacy of Finnish children. For the Olympians, libraries were resources that helped them to find books of interest without any financial investment. Almost all the Olympians reported active reading as one of their favorite hobbies. Parents and home atmosphere were reported as the second most frequent factors (N=12) that helped the Olympians to develop their talent. Olympians mentioned things like "academic atmosphere," "supportive atmosphere without any pressures," "freedom to explore things," "older siblings and their homework," and "genetic heredity" as examples of their supportive home atmosphere.

The Finnish Olympians emphasized their own interests and efforts as key factors in their talent development. They have mentioned " good memory," "self-discipline," "hating to lose", "desire to compete," "my own inner drive," and "my early learning in math and reading" as important factors influencing their development. The teachers

are given credit, too. Ten Olympians reported "excellent teachers" and "teachers' active encouragement" as important factors in their talent development (Tirri 2000).

The Finnish Olympians reported very few hindrances to their development. Only the items "Not enough challenge" and "Courses were taught at too low a level for me" were ranked as factors hindering some of their talent development. However, one should observe that the Olympians had the most variance in these two items. Evidently these two hindrances were greater for some of the Olympians than for the others. The parents were very much in accord with their children on the factors that hindered the development of the academic talent. They rated the lack of challenge and too easy courses as the most influential factors hindering the development of their children's talent (Tirri 2000).

Those who had experienced other negative school influences were given a chance to describe them in a qualitative way. The most frequently mentioned negative experience was the envy of other children. Twenty Olympians reported "bullying," "harassment," "ignorance," and "envy and jealousy" of their schoolmates as their dominating school experiences. The Finnish educational system with its emphasis on equality was also mentioned as a hindrance to their talent development. This trend includes lack of special arrangements for the gifted students and teaching that was directed to the mediocre students. These negative experiences had caused frustration and lack of interest in the Olympians (Tirri 2000).

The influence of the Olympiad program

The Olympians were asked to evaluate the influence of the Olympiad program on their talent development. More than half of the Olympians expressed the view that they would not have accomplished as much without the program (see Table 2). Almost half of the Olympians viewed participation as helping them to accept their talents. They reported that international contacts made them realize their talents better and increased their self-confidence. Only 2% of them thought it hindered the development of their talent in any way. Sixty percent of the Olympians reported that the program had increased their awareness of educational opportunities to some degree. However, most of the Olympians reported that they had already made their educational choices before the participation. The participation mainly confirmed their earlier plans. More than half of the Olympians viewed participation in the program as positively changing others' attitudes toward them. They reported that the publicity and respect from others was a positive experience. Only 2% of them reported negative changes in peoples' attitudes. These individuals stated that they had always been regarded as weird, anyway.

More than 60% of the Olympians recommended including elements of the Olympics in gifted programs. They had little experience of negative consequences or burnout due to the program. Over 70% of the Olympians had not experienced any negative consequences and only eight percent reported burnout due to the Olympics. Many of them emphasized the freedom of choice to participate and the short-term commitment required. Those who reported burnout due to the Olympics explained it as physical illness or disappointments caused by their performance. A few Olympians expressed the view that the Olympiad program was too intensive and abstract.

Most of the Olympians reported that the Olympiad experience was an encouraging and interesting experience that seemed like an adventure. Several Olympians wrote qualitative comments describing their experiences in the following ways. "My first time in a foreign country," "It was wonderful to meet other talented people with the same interest," "For the first time in my life I was really challenged," "I learned how much I knew by comparing my knowledge with the talents of students from other countries," "It really boosted my self-confidence!" "I got new friends," "I had a romance with a foreign girl," and "It was a break from the Army."

It is possible that the Finnish Olympians represent gifted individuals who have been motivated mostly by their own inner drive. They had not been pressured or trained only for the Olympiad experience. This trend was revealed in their qualitative responses, and it can explain the low pressure and burnout experienced by them. They had always studied hard, and the Olympiad program brought them international contacts and social experiences that they remembered for years.

Table 2. Olympians' assessments of the Olympiad program (Finland)

Would the Olympian have accomplished as much without the program? (%)	
Yes	43
No	57
Did the Olympiad program make the Olympian aware of educational opportunities? (%)	
Very well, some	42
Little	28
None	30
Did participation in the program change others' attitudes toward the Olympians? (%)	
Positive changes	55
No change	43
Negative changes	2
Missing	1
Did participation help/hinder the Olympians in accepting their talents? (%)	
Helpful	45
Neither helped nor hindered	20
Hindered	2
Not applicable	33 (incl. 1% missing)

Actualizing mathematical giftedness in the professional lives of the Olympians

The academic success of the Olympians continued in their studies at universities. They reported that the transition to university studies was very easy (4.5 on a scale of 5). However, only 12% of the Olympians had had a chance to participate in a special program or individualized opportunities at their universities. The Olympians remained very independent in their studies; less than a half (40%) of them reported having mentors to aid their development. Compared to the American sample, the Finnish Olympians found the transition to university easier than did their American colleagues, and they had been provided fewer special programs and individualized opportunities as well as less mentoring during their university studies (see Campbell 1996b for the American results).

The majority (80%) of the Finnish Olympians had already earned their first graduate degree (see Table 3). Twenty-two percent of them had completed a second graduate degree, and almost half of them had already earned their doctorate degree (see Table 3). The data included many students, and most of them were planning to earn their doctorates in the future (see Table 4).

Table 3. The degrees earned by the Olympians

Graduate degree	(%)
Completed	80
Not completed	13
Data missing	7
Second graduate degree	(%)
Completed	22
Not completed	71
Data missing	7
Ph.D.	
Completed	43
Not completed	47
Data missing	10

Evidently, an academic career was the first choice for the majority of the Finnish Olympians. Table 4 provides information on the career choices of the Olympians. We can see that researcher was the leading current position for both male and female Olympians. The researcher title included both permanent and post-doc positions in the Universities and research centers. Only six of the Olympians were university professors. The lack of professors in this sample can be explained by the young age of the Olympians. The majority of them were 21 to 40 years old. In Finland, it is very unusual to become a professor before the age of forty. However, many of those who carry the title "researcher" today are the professors of the future. The majority of the Olympians had studied at the Universities of Technology and graduated with a degree

in engineering. Those Olympians who didn't continue in academia chose a career as an engineer (10%) or as a CEO or a manager (14%) in leading Finnish companies like Nokia. Many of these positions were associated with modern information technology and computer science. However, some of the Olympians (10%) identified themselves so strongly with computers that they called themselves "computer specialists." Only a few of the Olympians had chosen to become a teacher or a physician (see Table 4). We can conclude that the Finnish Olympians remained faithful to their earlier interests in science, and they chose professions in which they could continue to actualize their mathematical talent. The career choices of the Finnish Olympians are very much in accord with the ones made by their American counterparts (Campbell 1996b).

Table 4. The career choices of the Olympians

Profession	All (N=158)	Males (N=150)	Females (N=8)
Researcher	53 (35.5%)	49 (31%)	4 (50%)
Engineer	16 (10.1%)	15 (9.4%)	1 (12.5%)
Teacher	7 (4.4%)	6 (3.8%)	1 (12.5%)
Physician	5 (3.2%)	4 (2.5%)	1 (12.5%)
Computer Specialist	16 (10.1%)	16 (10.1%)	0 (0%)
Professor	6 (3.8%)	6 (3.8%)	0 (0%)
CEO or manager	22 (13.9%)	21 (13.3%)	1 (12.5%)
Student	30 (19.0%)	30 (19%)	0 (0%)
Retired	1 (0.6%)	1 (0.6%)	0 (0%)
Unemployed	2 (1.3%)	2 (1.3%)	0 (0%)

The Finnish Olympians had been extremely productive measured by the number of academic publications, having published a total of 1006 articles in refereed professional journals (see Table 5). An interesting observation is that the females in our sample had published slightly more articles than the males. In the American study, the female chemistry Olympians produced more publications than the males, as well (Verna & Campbell 2000). However, the females had not published any books, and only one female had produced two patents. Both males and females had presented many research papers at international conferences (see Table 5).

Table 5. Academic productivity of the Olympians

Academic Productivity	All	Male	Female
Articles published	1006 (6.4)	930 (6.2)	76 (9.5)
Books published	53 (0.3)	53 (0.3)	
Research papers presented	1143 (7.2)	1096 (7.3)	47 (5.9)
Patents	38 (0.2)	36 (0.2)	2 (0.3)

How do the Olympians explain their academic and professional success?

Considering the degrees earned and the publications produced, the Olympians have been very successful in their career. Are academic successes due to talent alone or to hard work? The Olympians were asked to rate their perceptions on the attributions of ability and effort regarding their academic success. The SaaS instrument (Campbell 1996b) used a five-point Likert scale ranging from strongly disagree to strongly agree. The self-confidence attribute attitude scale included twenty-nine items measuring the Olympians' attributions. The four-factor solution with its Principal Component Analysis grouped the variables as follows. **Factor 1 "Success due to Ability"** included variables like: "I do poorly only when I do not work hard enough," "The smart kids tried the hardest," and "Why work in an area where your ability is low?" **Factor 2 "Failure due to a lack of Ability"** included items like "There are some things you can't do no matter how hard you try," "You have to have the ability in order to succeed in most things," and "When I did poorly in school it was because I did not have the needed ability." **Factor 3 "Success due to Effort"** included items like "You can be successful in anything if you work hard at it," "Self-discipline is the key to school success," and "Poor study habits are the main cause of low grades." **Factor 4 "Failure due to a lack of Effort"** included items like "I worked harder if I liked the teacher," "Being smart is more important than working hard," and "When I scored low on a test, it was because I didn't study hard enough."

Figures 1-4 demonstrate how the Olympians ranked in respect to these four factors. Figures 1 and 2 illustrate that the Olympians considered both ability and effort important for their academic success. The differences are very small but effort is considered slightly more important (26.1%) than ability (24.2%). None of the Olympians denied effort completely regarding their success and only 13.4% disagreed strongly on the importance of effort. Only three Olympians (1.9%) denied ability totally and only 15.3% of them disagreed strongly on the importance of ability (See Figures 1 and 2).

The Finnish Olympians tended to attribute success and failure to both ability and effort. The German participants have been reported to attribute success and failure more to ability than to effort (Heller & Lengfelder 2000). On the other hand, the American and the Taiwanese participants have attributed success and failure more to effort than to ability (Wu & Chen 2000, Feng & Campbell 2000). In an American study, a small significant difference between the males and females was found with regard to ability. The female American Chemistry Olympians considered ability to be a more important factor for success than did the males. However, no difference was found for the effort factor (Verna & Campbell 2000).

Figure 1. Success due to ability

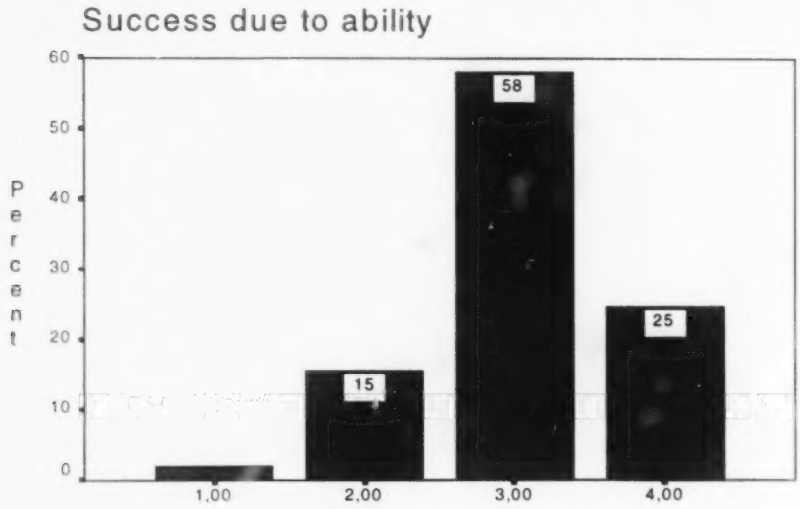
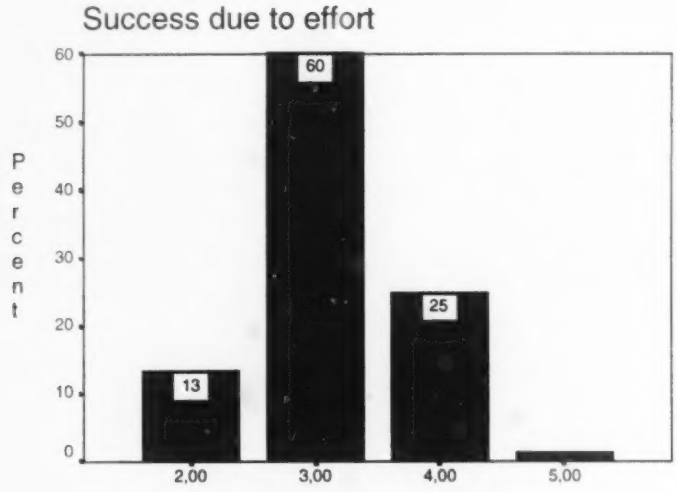


Figure 2. Success due to effort



The Finnish Olympians considered their failures to be due more to ability than to a lack of effort. Sixty-three (40.1%) Olympians evaluated their failures as being due more to lack of ability, and fifty-one (32.4%) Olympians ranked the failures due more to lack of effort (see Figures 3 and 4).

Figure 3. Failure due to the lack of ability

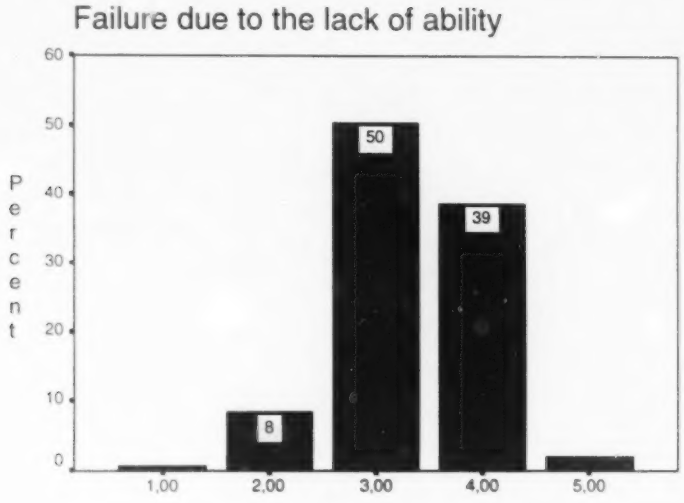
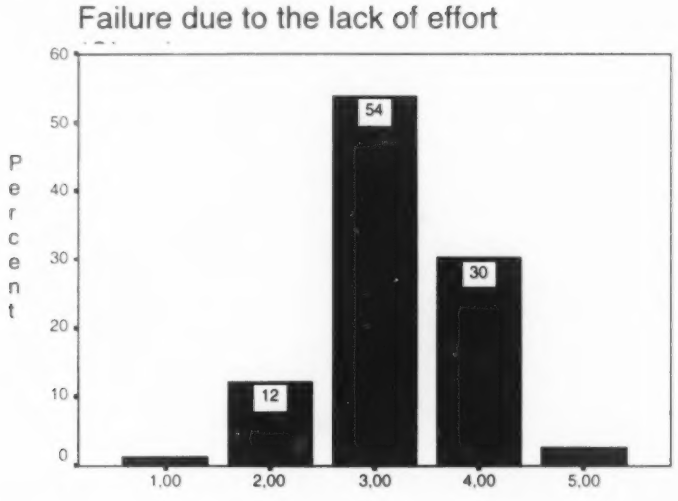


Figure 4. Failure due to the lack of effort



Concluding remarks

The empirical findings reported in this paper indicate that the Finnish Olympians actualize their mathematical talent by choosing a career in science. The majority of them are researchers in academia or engineers in technical fields. The Olympians

have been very successful in their graduate studies, and they have published articles and books related to their fields. The Finnish Olympians have been very independent learners, and they attribute their academic success to both ability and effort. Their own interests and efforts have been the key factors in their talent development and career orientations. The Olympiad program had increased their self-confidence and confirmed the career choices they had already made. The Finnish Olympians have been motivated mostly by their own inner drive. A conducive home atmosphere and supportive teachers had been helpful but the Olympians viewed themselves as the most influential person in developing and actualizing mathematical talent. The identification of mathematical talent and encouragement gained from the Olympiad program has once again produced long-term positive consequences for career contributions (Campbell 1996b).

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